



US Geological Survey - Woods Hole Field Center

Current Research Projects at USGS Woods Hole Science Center

• The Massachusetts Bay Experiment - Verifying Predictions of Pollutant and Sediment

Project start date: 10/01/1997 Project end date: 09/30/2002

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This project, in cooperation with the Massachusetts Water Resources Authority (MWRA), has been providing continuous oceanographic measurements (currents, temperature, suspended sediments) near the outfall to assess its effects, to understand the sediment transport system in the Massachusetts Bays, and to refine and verify scientific predictive capabilities for the transport, fate, and environmental effects of wastes discharged to a coastal ocean.

• New York Bight and Long Island Sound Regional Pollution Studies

Project start date: 10/01/1995 Project end date: 09/30/2002

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The Long Island Sound estuarine system (LIS) and the New York Bight (NYB), offshore of the New York - New Jersey metropolitan area, are heavily used and the seafloor has been affected by human activities. There has been widespread contamination of the bottom sediments, and degradation of benthic habitats. Currently, this project is synthesizing results of earlier field and laboratory studies of the sediment dynamics, geochemical processes that control the distribution of contaminants, and areas of benthic habitats. The project's long-term goal is to develop predictive capabilities for pollutant and sediment mobility and fate that can be used to guide appropriate and sustainable use of the coastal waters of Long Island Sound and New York Bight.

• The Flux of Metals from Contaminated Coastal Sediments

Project start date: 10/01/1999 Project end date: 09/30/2002

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Toxic metals contaminate harbors and coastal waters around every U.S. metropolitan center. This project is using and developing new technologies that allow dramatic improvement in measuring the flux of many toxic metals (Ag, Pb, Cu and Zn) between contaminated sediments and the overlying water. Current work in Massachusetts Bay and Boston Harbor is investigating the impact of the change in the sewage outfall location from the harbor mouth to the site 9 miles eastward in Massachusetts Bay on September 6, 2001. The new methodology is directly transferable to contaminated sediments in fresh waters and coastal areas throughout the U.S.

• Geology Of Benthic Habitats National Studies: Atlantic and Gulf Coast Regions

Project start date: 10/01/1999 Project end date: 09/30/2004

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This project investigates the influence of sea floor geology, geologic processes, sediment supply, freshwater input, and sea floor disturbance on the distribution, abundance, and diversity of fishery resources and benthic ecosystems within the Atlantic and Gulf Coast Regions. We describe physical impacts to fishing grounds by fishing gear and correlate biotic habitats with geologic parameters using mapping, sampling, and observational tools such as multibeam and LIDAR,



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airborne sensors, photo/video, and subs/ROVs. Areas of study are: New York Bight (B. Butman, PI); Northern Gulf of Mexico (K. Scanlon, PI); Georges Bank and New England Shelf (P. Valentine, PI); Gulf of Mexico: Lower Suwannee River Estuary (E. Rabbe, PI)

• Marine Gas Hydrates

Project start date: 10/01/1999 Project end date: 09/30/2004

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Gas hydrate is a crystalline solid formed of water and gas. It looks and acts much like ice, but it contains huge amounts of methane and it exists in very large quantities in marine sediments in a layer several hundred meters thick directly below the sea floor and in association with permafrost in the Arctic. It is important for three reasons: 1. It may become a major energy resource, 2. It has important effects on sea floor sediment stability, influencing collapse and landsliding, 3. The hydrate reservoir may have strong influence on climate, as methane is a significant greenhouse gas. This project seeks to learn to identify gas hydrate by remote sensing and to understand the processes that control methane hydrate in the natural environment, such as concentration into possibly extractable accumulations, change in strength of sediments and generation of overpressures, processes of seafloor mobilization, and processes allowing transfer of methane to the atmosphere.

• Submerged Paleo-shorelines of the U.S. Atlantic and Gulf of Mexico Coasts

Project start date: 10/01/2000 Project end date: 09/30/2003

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Several USGS mapping projects along the East Coast and eastern Gulf of Mexico continental shelf have discovered paleo-shoreline deposits from at least three discrete sea-level stillstands during the most recent deglacial episode. Each stillstand was terminated by a rapid rise event. Currently, there are predictions that we may be facing a more rapid sea-level rise like that which characterized most of the late Quaternary. This project will study seven sites of paleo-shorelines having a wide range of geologic settings and different tectonic and isostatic histories, with the object of learning how the modern coastal system might respond to a renewed period of rapid sea-level rise.

• South Carolina Coastal Erosion Study - Phase II

Project start date: 10/01/1999 Project end date: 09/30/2004

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The primary goal of the USGS Coastal Erosion Study in South Carolina is to learn to predict coastal change (erosion and accretion) by achieving an understanding of factors that control sediment movement. This work is being done in close collaboration with Coastal Carolina University and the University of South Carolina. We are finding that much of the shoreline behavior on the Atlantic coast is influenced by the locations of resistant or easily eroded sediments along the shore, which owe their nature to the antecedent geologic environment. By using surface sediment distribution, subsurface stratigraphy of the lower shoreface and inner shelf, and subaerial components of the coastal system to interpret and map the pre-existing coastal features, a conceptual understanding of the present sediment dynamics can be seen that



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results from the sequence of pre-existing coastal conditions. Over the three years of the project, the inner shelf and lower shoreface will be mapped using high-resolution sidescan-sonar, subbottom profilers (CHIRP, Geopulse boomer), fathometer, interferometric sidescan/bathymetry, and sediment samples.

Glacier Studies

Project start date: 11/01/1996 Project end date: 09/30/2006

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A rise in sea level from both the melting of glaciers and steric increase in volume is a predicted consequence of global climate warming, and global circulation models predict that warming trends during the next 100 years will be strongly amplified in both polar regions. The Glacier Studies Project, part of a multi-agency Climate Change Research Initiative Program (formerly, the U.S. Global Change Research Program), is mapping and monitoring the sensitive polar regions of the "cryosphere" (composed of glaciers; sea, lake, and river ice; snow cover; and permafrost). A global baseline study of the areal extent of glaciers on the Earth using Landsat images from 1972-1982, a major international effort involving collaboration of more than 80 scientists from 45 institutions in 25 nations to produce a Satellite Image Atlas of Glaciers of the World (USGS Professional Paper 1386 A-K), will be completed in FY2004. A series of accurate baseline maps of the dynamic coastline of Antarctica using satellite images to map glaciological characteristics (for example, floating ice, grounded ice, etc.) at the Antarctic coastline and to measure velocities of outlet glaciers, ice streams, and ice shelves will be completed in FY2006. A collection of maps spanning more than 200 years, proxy environmental data spanning the late Pleistocene and Holocene, and photographs spanning more than 115 years, are being used to document the impact of regional climate change on the glaciers of Alaska.

Caribbean Tsunami and Earthquake Studies

Project start date: 10/01/1999 Project end date: 09/30/2004

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Puerto Rico and the Virgin Islands are located at an active plate boundary between the North American plate and the northeast corner of the Caribbean plate, where there is a significant seismic risk. Plate movements have caused large (7.5-8) magnitude earthquakes. Large tsunamis have hit Puerto Rico and Hispaniola, reportedly killing 1800 people in 1946 and 91 people in 1918. Knowledge of the causative mechanisms and the likely hazards of earthquakes and tsunamis will improve the safety of residents and protection of coastal resources because government agencies and the public can use the information to improve building codes, encourage safer zoning, and assist public education for response to hazards. This project is a study of the plate motions, the shallow and deep coupling between the plates, mapping the resultant shallow and deep plate-boundary deformation using a variety of geophysical methods. The project is working from recommendations by a workshop held in San Juan PR in March, 1999.

The Coastal Sedimentary System: Northern North Carolina

Project start date: 10/01/1999 Project end date: 09/30/2005

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with collaborators:

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Stan Riggs, Eastern Carolina University

This project is mapping the regional coastal sedimentary system of inner shelf of northern North Carolina in order to understand the Quaternary evolution of the coastal system, especially coastal erosion. This study area includes ~250 kilometers longshore distance of the inner shelf, shoreface and coastal area between Duck and Cape Lookout, to ~10 kilometers offshore. It lies, in part, off



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the Cape Hatteras National Seashore and Pea Island National Wildlife Refuge and includes Oregon Inlet. Inner-shelf areas are mapped using high-resolution sidescan-sonar (100% coverage), subbottom profilers (CHIRP, Geopulse boomer, mini-sparker), fathometer, interferometric sidescan-sonar, and sediment grab sampler. Erosion rates that have been determined from historic measurements and recent measurements of the USGS SWASH system are being studied in conjunction with mapping data to identify areas where rates are expected to significantly change in the near future due to alongshore shifts in zones of accelerated erosion. The Quaternary back-barrier section within the Albemarle-Pamlico estuarine system and associated barrier islands is being mapped using high-resolution sidescan sonar, bathymetry, subbottom profiling, ground-penetrating radar where applicable, aerial photo analysis of the adjacent land areas and shallow cores. Five core holes will be drilled in a transect along the barrier island. Shoreface Mapping is using interferometric sidescan/bathymetry and a CHIRP subbottom system, with amphibious vehicles as needed. A National Park Service Geologic Resources Inventory (GRI) will contribute the knowledge of these areas to the rest of the mapping program. And an annual workshop including technical presentations, panel/round table discussions, and outreach presentations designed specifically for regulators, policy makers, and legislators is being convened.

Coastal Erosion Research with SWASH

Project start date: 10/01/1999 Project end date: 09/30/2004

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SWASH is a vehicle-based GPS system for measuring regional-scale shoreline position as the mean high water (MHW) contour's intersection with the beach foreshore. SWASH is being applied in a systematic program of measurement on Cape Cod (45 kilometers of coast) and Cape Hatteras (130 kilometers of coast) with intensive surveys in response to storms and regularly scheduled surveys (bi-weekly on Cape Cod, monthly on Cape Hatteras) designed to continually update pre-storm information. The primary objective of this project is to understand the processes causing storm-induced erosional hotspots, and in doing so to develop a method for predicting their locations prior to future storm impacts. Secondary objectives are to provide data for evaluating the error in long-term shoreline change assessments, and to provide data for determining statistically well-constrained long-term shoreline change rates in North Carolina.

Sea and Lake Floor Mapping

Project start date: 10/01/1995 Project end date: 09/30/2002

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This project produces digital maps of sea-floor areas using new high-resolution mapping systems that are revolutionizing the way we think about the sea floor. They provide a fundamental framework for research and geologic information for a wide range of management issues. Techniques and instrument systems used include sidescan sonar, multibeam sonar, high resolution seismic reflection profiling, bottom imaging, and direct sampling. Our mapping group has mapped and characterized the sea floor in waters offshore of New York, the most heavily populated, and one of the most heavily used coastal regions of the United States; the Hudson Shelf Valley, the ancient channel of the Hudson River across the continental shelf - a sink and potential conduit for the transport of contaminants in the sediments; the Historic Area Remediation Site (HARS), off New Jersey - used for disposal since the last century, it is now being remediated; Lake Mead, where our geologic mapping data and historic information show the development of turbidite flow systems in the lake from source to sink, the first synthesis of the lake floor geology in its 65 year history; Gulf of Mexico channels through an area of intense salt deformation show how turbidite sediments were deposited and provide models for oil explorationists; Great South Channel, on the far western part of Georges Bank, has widely diverse sea floor habitats that support an important commercial fishery.



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• National Knowledge Bank for CMGP

Project start date: 10/01/2000 Project end date: 09/30/2010

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The capabilities of the digital and information revolution must be applied to preserve and utilize the data, information, and knowledge of the Nation's coastal and marine realms for present and future benefit. A National Research Council review of the USGS Coastal and Marine Geology Program (CMGP) called for development of a National Knowledge Bank (NKB). This project is the mechanism to define, develop, and implement an NKB, and to coordinate with other earth-science knowledge-management efforts (e.g., Gateway to the Earth, U.S. Digital Earth, National Atlas of the U.S.). Its purpose is to ensure that data and knowledge are readily and usefully available to address multiple, complex issues of the coastal ocean, the sea floor, and the geologic/hydrologic processes which affect them. All three CMGP Centers will participate. The NKB will include links to the knowledge assets of other sources of coastal and marine geoscience information.